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Additions to the lichen biota of Iran

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Abstract — *Lepraria caesioalba* (chemotype III), *L. rigidula*, and *Ochrolechia turneri* are reported as new to Iran. The record of *O. turneri* is the first for Asia and the genus *Ochrolechia* is reported from Iran for the first time. All taxa are characterized, and notes on the distribution, ecology, and differentiation from similar species are provided. Further records of the under-collected species *L. vouauxii* are also presented.

Key words — lichen substances, neglected habitats, sterile lichens

Introduction

The lichen biota of Iran has been recently subjected to considerable lichenological activity, resulting in several publications (Hadji Moniry et al. 2005, Sohrabi & Alstrup 2007, Sohrabi & Sipman 2007, Kukwa & Sohrabi 2008), and the compilation of two checklists (Seaward et al. 2004, 2008). To date, 646 species of lichens, lichenicolous, and allied fungi have been reported from the country (Seaward et al. 2008, Kukwa & Sohrabi 2008), and a comparison between the checklists shows that 243 taxa have been added in a period of only four years. This suggests that the number of species in Iran is still under-estimated and many additional taxa can be expected.

During the revision of lichens collected by the first author, three species identified have never been reported from Iran; these are all sorediate, permanently or commonly sterile, crustose lichens and the least studied generally, since identification and taxonomy are based mainly on secondary chemistry. This paper presents the first localities for two *Lepraria* species, and the first record of the genus *Ochrolechia* from Iran. Brief notes on their morphology, chemistry, distribution, and ecology for each species, as well as on similar taxa, are provided.

Material and methods

Studied material is deposited in UGDA and the the private herbarium of MHM. Comparative specimens studied are housed in BM, E and UGDA. Morphology was studied using a stereomicroscope. Chemical analyses were carried out by thin layer chromatography (TLC) in solvent systems A and C according to the methods of Orange et al. (2001).

The taxa

Lepraria caesioalba (B. de Lesd.) J.R. Laundon, Lichenologist 24: 324. 1992.
≡ *Crocynia caesioalba* B. de Lesd., Bull. Soc. Bot. France 61: 84. 1914.

Morphology: The thallus is typical for members of the *Lepraria neglecta* group: grey, often with a bluish tinge, thick, with diffuse or obscurely lobate margin and consisting of coarse granules (see also Tønsberg 1992, 2004; Sipman 2004, Flakus & Kukwa 2007).

Chemistry: *Lepraria caesioalba* is chemically variable: 3 to 5 chemotypes differing in depsidone and/or fatty acid composition have been distinguished (Laundon 1992, Leuckert et al. 1995, Tønsberg 2004). TLC of the Iranian specimen revealed atranorin and psoromic acid; thus it belongs to chemotype 3 according to Leuckert et al. (1995), and is similar to chemotype 5 distinguished by Tønsberg (2004). Leuckert et al. (1995) occasionally detected angardianic/roccellic and 2'-O-demethylpsoromic acids in addition to psoromic acid, and Tønsberg (2004) and Kukwa (2006) reported also rangiformic acid. These substances were not found in the Iranian specimen. Thallus P+ lemon yellow, K+ yellow.

Ecology — *Lepraria caesioalba* grows on soil, rocks, tree bark or mosses (Laundon 1992, Tønsberg 1992, 2004; Sipman 2004, Flakus & Kukwa 2007, Saag et al. 2009). The specimen reported here was found on soil and mosses.

Distribution — The species is very widespread, being found in areas with a cool climate on all continents except Africa and Antarctica (Laundon 1992, Tønsberg 1992, 2004; Sipman 2004, Flakus & Kukwa 2007, Saag et al. 2009). Here it is reported as new to Iran.

Specimen examined—**IRAN. Northern Khorasan:** 75 km from Bojnourd, Darkesh Reserved Region (37°24'–37°27'N, 56°41'–56°49'E), Nargesli, alt. 2550 m, on mosses and soil—31.3.2009, M. Haji Moniri 2417 (herb. Haji Moniri).

Reference material examined—**FRANCE. Seine-et-marne:** Forèt de Fontainebeau, on mosses and other lichens—July 1913, M. Bouly de Lesdain (**holotype**-E; TLC by J.R. Laundon: atranorin, fumarprotocetraric acid, roccellic acid).

Comments — *Lepraria caesioalba* and the related taxa, *L. alpina* (B. de Lesd.) Tretiach & Baruffo 2006, *L. borealis* Loht. & Tønsberg 1994, *L. granulata* Slav.-Bay. 2007, *L. neglecta* (Nyl.) Erichsen 1957, and *L. zeorinica* (L. Saag) Kukwa

2009, form the so-called *Lepraria neglecta* group. All these species grow in rain-exposed habitats; their thallus has a diffuse to obscurely lobate margin and consists of coarse granules. Members of the group are superficially almost indistinguishable, but they are identifiable on the basis of different secondary lichen substances. Among them, *L. caesioalba* can be easily recognized, as it is the only species of the group producing depsidones, fumarprotocetraric, psoromic or stictic acid, all often accompanied by biosynthetically related metabolites (Tønsberg 2004, Kukwa 2006, Slavíková-Bayerová & Fehrer 2007, Flakus & Kukwa 2007, Fehrer et al. 2008, Kukwa & Flakus 2009, Saag et al. 2009).

Recently, three specimens of *L. caesioalba* varying in depsidone content have been included in molecular studies, and the species appeared to be polyphyletic. The specimen containing psoromic acid forms a well supported group together with the fumarprotocetraric acid chemotype (Ekman & Tønsberg 2002); the last one is believed to represent *L. caesioalba* s.str., as the holotype also contains fumarprotocetraric acid (see Laundon 1992). The specimen with stictic acid is distantly related to both other specimens (Ekman & Tønsberg 2002). Perhaps all chemotypes deserve species status (Tønsberg 2004). As there is still no nomenclatural segregation, the chemotypes are still treated in *L. caesioalba*.

Lepraria rigidula (B. de Lesd.) Tønsberg, Sommerfeltia 14: 205. 1992.
≡ *Crocynia rigidula* B. de Lesd., in Hue, Bull. Soc. Bot. France 71: 331. 1924.

Morphology: The thallus is grey, bluish-grey or white-grey, leprose, with diffuse margin. The soredia are fine to coarse, sometimes aggregated into consoredia, with distinct and long (up to c. 100 μm) projecting hyphae on the surface of at least some soredia (see also Tønsberg 1992, 2004, Kukwa 2006, Flakus & Kukwa 2007, Saag et al. 2009).

Chemistry: Atranorin and nephrosteranic acid were detected, which agrees with the results presented by Tønsberg (1992) and Leuckert et al. (1995). Thallus C–, K+ yellow, and P+ yellowish or P–.

Ecology — *Lepraria rigidula* usually grows on bark of deciduous trees, but it has also been reported from a range of substrata, including lichen thalli (Tønsberg 1992, 2004; Flakus & Kukwa 2007, Saag et al. 2009). The specimen reported here was found on epigeic bryophytes.

Distribution — The species is very widespread, being reported from Africa, Asia, Antarctica, Europe, and North and South America (Tønsberg 1992, 2004; Kümmerling et al. 1995, Øvtedal & Lewis Smith 2001, Flakus & Kukwa 2007, Saag et al. 2009). In Asia, it is known only from Turkey (Kümmerling et al. 1995, John et al. 2000) and the Russian Arctic (Kukwa & Zhurbenko, unpublished data). Here it is reported as new to Iran.

In the locality presented here, *L. rigidula* was accompanied by *L. vouauxii* (Hue) R.C. Harris 1987, a lichen known only from three localities in Iran (Seaward et al. 2004). During the course of this study, we found additional specimens of this taxon. As the species is still scarcely reported in Asia (including Iran), both new findings are presented below.

Specimen examined—**IRAN. Northern Khorasan:** 75 km from Bojnourd, Darkesh Reserved Region (37°24'–37°27'N, 56°41'–56°49'E), Nargesli, alt. 2550 m, on epigeic bryophytes—31.3.2009, M. Haji Moniri 2418 (herb. Haji Moniri).

Reference material examined—**GREAT BRITAIN. Scotland:** Pitlochry, by side of River Tummel, over mosses on soil over rocks—June 1914, J. McAndrew (**holotype**-E).

Specimens of *L. vouauxii* examined—**IRAN. Northern Khorasan:** Darkesh Reserved Region, Nargesli, alt. 2550 m, on epigeic bryophytes—31.3.2009, M. Haji Moniri 2415 & 2416 (herb. Haji Moniri). Ghareaghaj, alt. 1415 m, on mosses and soil—29.3.2005, M. Haji Moniri 1976 (herb. Haji Moniri).

Comments — *Lepraria rigidula* is the only species of the genus containing nephrosteranic acid and is thus very characteristic; a few other taxa also produce fatty acids as diagnostic substances (e.g. *L. borealis*, *L. celata* Slav.-Bay. 2006, *L. granulata*, *L. jackii* Tønsberg 1992 and *L. toensbergiana* Bay. & Kukwa 2005), but all of them have coarser (*L. borealis* and *L. granulata*) or finer (e.g., *L. celata*, *L. jackii, L. toensbergiana*) soredia, and all lack nephrosteranic acid (e.g. Tønsberg 1992, Lohtander 1994, Flakus & Kukwa 2007, Fehrer et al. 2008, Saag et al. 2009).

Ochrolechia turneri (Sm.) Hasselrot, Svensk Bot. Tidskr. 39: 130. 1945.

≡ *Lichen turneri* Sm., Engl. Bot. 12: tab. 857. 1801.

Morphology: The thallus of *O. turneri* is usually grey, thin and even, or more rarely thick, and then often folded. The species develops usually ± regular and discrete soralia, which sometimes tend to fuse and form a continuously sorediate crust in the centre of the thallus. The apothecia, absent in the Iranian specimen, are lecanorine with pruinose disc. For a detailed description see Tønsberg (1992) and Kukwa (2008).

Chemistry: Variolaric acid and one of the substances called 'microstictoides unknowns' (in lower Rf classes; for details see Kukwa 2008) were found in the Iranian specimen. Kukwa (2008) also reported alectoronic acid, a trace of atranorin and some additional unidentified compounds as accessory metabolites, and exclusively in apothecia gyrophoric and lecanoric acids. However these substances were not found in the studied material. Thallus cortex C–, K–; soralia C+ yellow, K–.

Ecology — *Ochrolechia turneri* has only been found on tree bark, mostly deciduous, but rarely on conifers (Kukwa 2008 and literature cited therein).

Distribution — The species is known almost exclusively from Europe (Kukwa 2008), but Hafellner (1995) reported it also from Africa (Canary Islands). Records from North America and Australia are doubtful (Brodo 1991, Kukwa 2008). Here it is reported as new to Iran, and also for Asia. It is the first species of the genus *Ochrolechia* from Iran.

Specimen examined—**IRAN. Khorasan Province:** 75 km from Bojnourd, Darkesh Reserved Region (37°24'–37°27'N, 56°41'–56°49'E), Nargesli, alt. 2550 m, on bark—31.3.2009, M. Haji Moniri 2426 (herb. Haji Moniri, dupl. UGDA-L–15320).

Reference material examined—**GREAT BRITAIN. England:** Norfolk, Coltishall, in a wood, on tree bark—s.datum, D. Turner (**holotype**-BM).

Comments — *Ochrolechia turneri* is characterized by its sorediate thallus containing variolaric acid as the major secondary metabolite, ± regular and well delimited soralia (at least at the edge of the thallus), and an epiphytic habitat (Kukwa 2008). The species can be confused with *O. alboflavescens* (Wulfen) Zahlbr. 1927 and *O. microstictoides* Räsänen 1936, as they also produce variolaric acid, and in the case of *O. alboflavescens* the soralia are regularly delimited. Both species, however, contain fatty acids, lichesterinic and protolichesterinic acids (Kukwa 2008). So far, they have not been reported from Iran (see Seaward et al. 2008).

Variolaric acid is also produced in *O. dalmatica* (Erichsen) Boqueras 1999 and *O. gowardii* Brodo 1991, two taxa superficially similar to *O. turneri*. They differ essentially in the production of gyrophoric acid in the soralia and the more restricted distribution range: *O. dalmatica* is known mostly from the Mediterranean, and *O. gowardii* from western North America and Scandinavia (Brodo 1991, Holien 1992, Jonsson 2002, Kukwa 2008).

European material of *O. turneri* has been mistaken for the somewhat morphologically similar *Pertusaria albescens* (Huds.) M. Choisy & Werner 1932, *P. amara* (Ach.) Nyl. 1872 and *P. ophthalmiza* (Nyl.) Nyl. 1865. All these species differ in chemistry: *P. albescens* and *P. ophthalmiza* produce fatty acids, and *P. amara* produces picrolichenic acid as the major secondary metabolite (Hanko 1983, Tønsberg 1992). In Iran, only *P. albescens* and *P. amara* have so far been reported (Seaward et al. 2008).

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